Charged Pion reconstruction

Status of TPC events reconstruction for pions and next steps for the measurement of the total cross section ($\pi^{\pm}$, Ar)

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TPC events Reconstruction

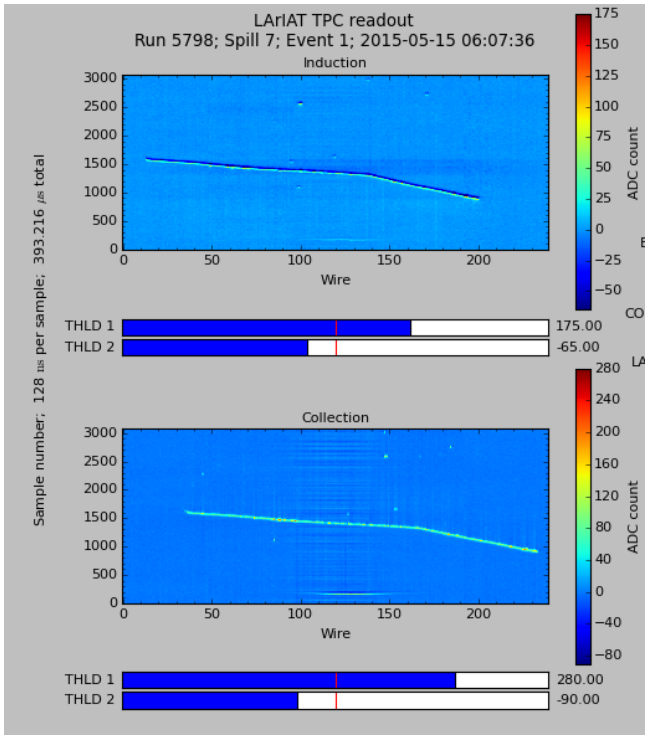
Preliminary TPC event Reco chain:
See "recotrack_lariat.fcl" in LArIATSoft repo - develop branch

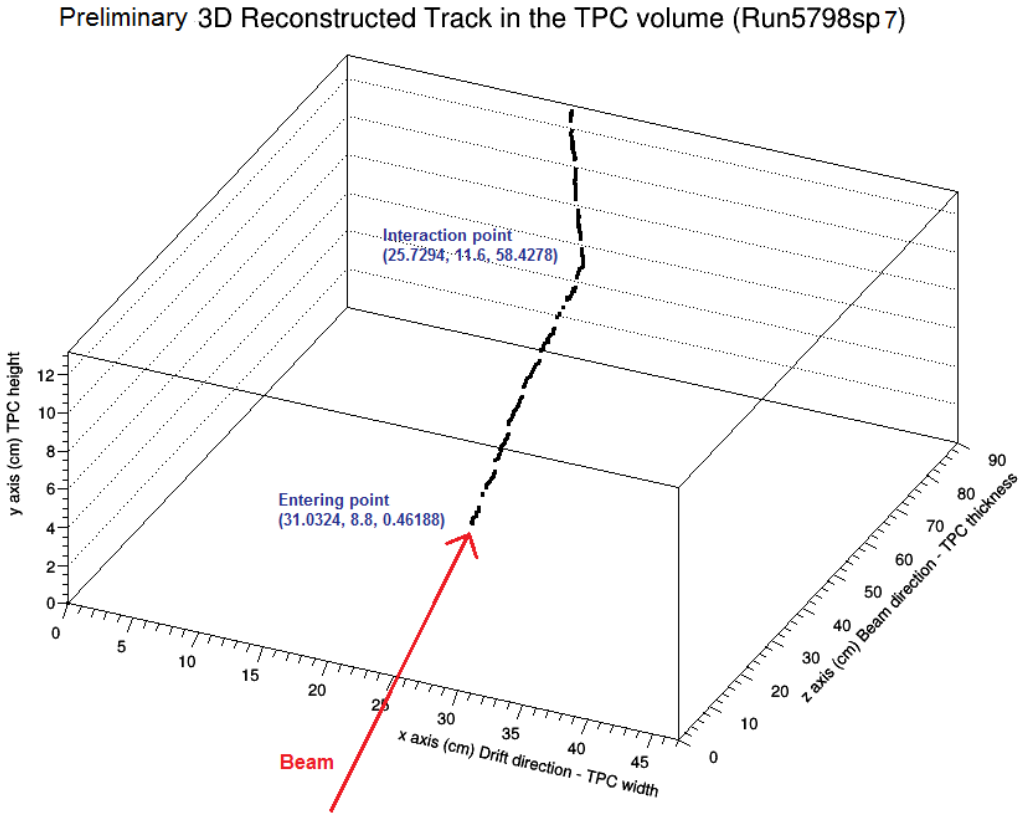
- Raw data to LArIATSoft readable data: FragmentToDigit
- TPC wires signals - noise deconvolution: CalWireT1034
- TPC wires signals - hit finding: GaussHitFinder
- Hits clustering: DBCluster
- Simple Tracking: SpacePoints

Other modules for the TPC data: HoughLineFinder, ClusterCrawler, CosmicTracker, BezierTrack...

Preliminary 3D Reco chain test(1)

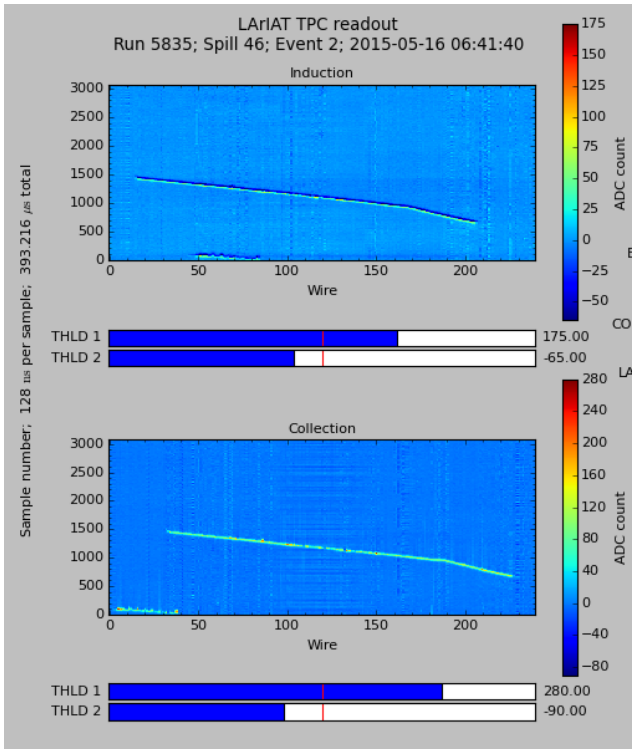
Run 5798 sp.7 trig.1: π^+ (ToF = 32 ns) Elastic scattering

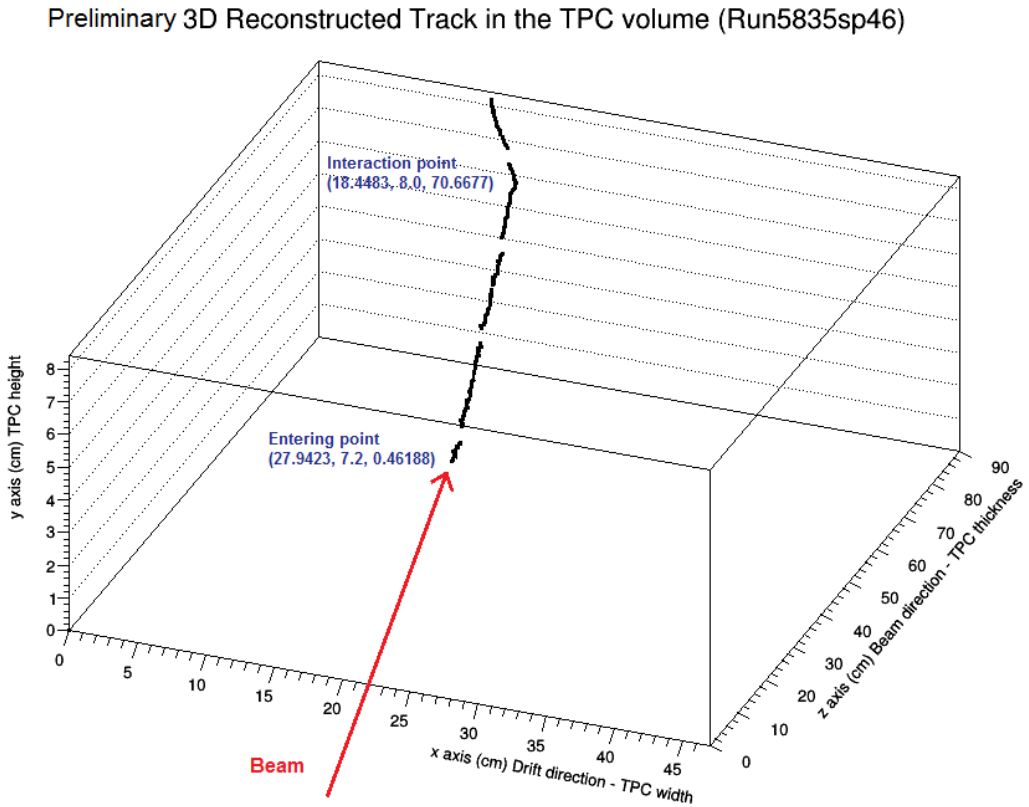




Preliminary 3D Reco chain test (2)

Run 5835 sp.46 trig.3: π^+ (ToF = 33 ns) Elastic scattering





Preliminary 3D TPC Reco chain

Actual issues and limitations on TPC pion events reco:

- Deconvolution in Calwire still needs to be improved to manage to have almost all the hits along a track well reconstructed
- SpacePoints, CosmicTracker and BezierTrack: compare the three algorithms results for same tracks (They work fine for almost straight tracks!!) $\rightarrow$ crossing beam particles, cosmics, elastic scattering events; modules for em shower reco need to be ported in LArIATSoft
- DBCluster + SpacePoints actually produce only a single cluster/track for an elastic scattering event (I guess ClusterCrawler would manage to produce two clusters in case of an elastic scattering) $\rightarrow$ algorithm to find the interaction vertex?

Next steps for TPC events Reco

- Calorimetry module (purity and recombination correction, charge to energy conversion)
- Match TPC & Beamline tracks (incident momentum and direction at the TPC, ToF...)
- Filter: select "clean events" for a first pion tracks analysis $\rightarrow$ 1-2 tracks in the TPC per trigger, selection by "Trigger label" before running the whole reco chain?
- π to μ discrimination for crossing tracks (ToF, Cherenkov, MuRS)

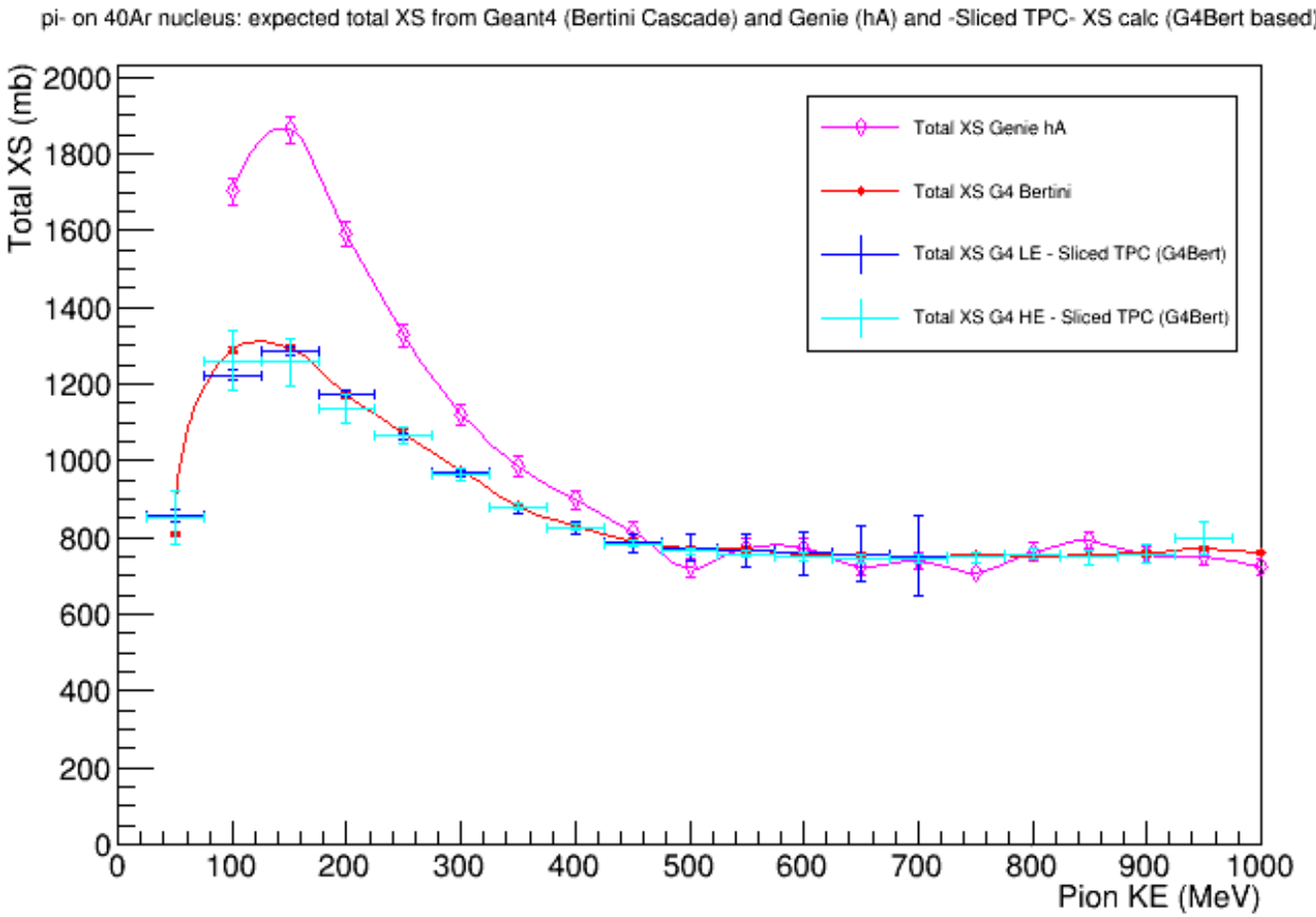
Total ($\pi^{\pm}$, Ar) cross section goal

Variables we need to apply the "Sliced TPC" approach to each charged pion track and to have a preliminary experimental measurement of the total ($\pi^{\pm}$, Ar) hadronic interaction cross section dependence on pion energy:

- Charged pion discrimination (PID)
- Incident direction and momentum of the charged pion at the TPC entrance window
- 3D Track and Interaction point (need to discriminate among hadronic interactions and pion decays or captures)
- Energy deposit along the track, ΔE associated with each point or group of points

Total ($\pi^{\pm}$, Ar) cross section goal

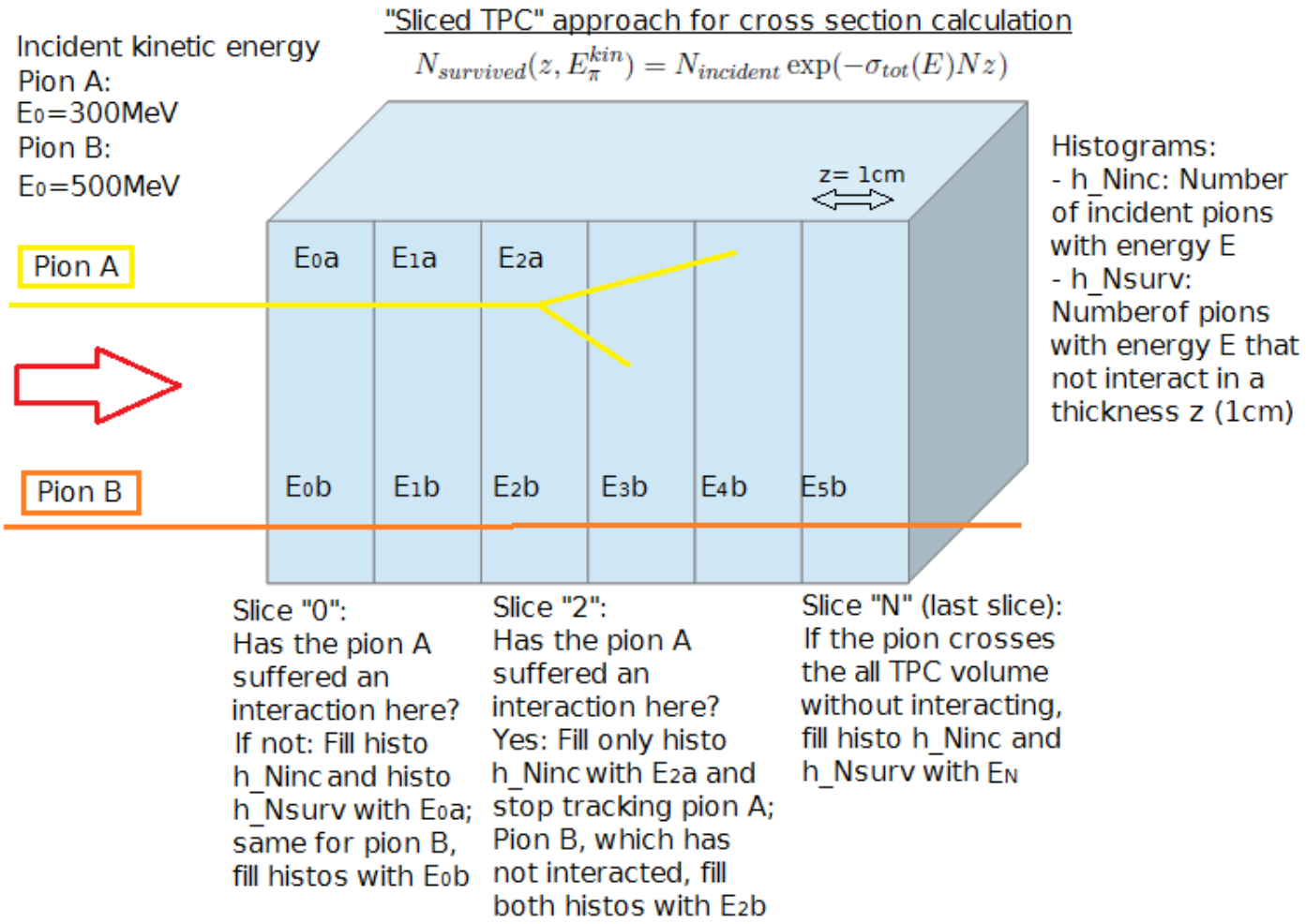
Total (π^{-}, Ar) cross section Geant4 prediction for the LArTPC volume and the two different beam energy ranges, applying the "Sliced TPC" technique (that has been validated compared with Geant4 Thin target results)



Backup

"Sliced TPC" approach

"Sliced TPC"' approach to evaluate total ($\pi^{\pm}$, Ar) cross section Geant4 prediction for the LArTPC volume



Total ($\pi^{\pm}$, Ar) cross section goal

Total (π^{+}, Ar) cross section Geant4 prediction for the LArTPC volume calculated with "Sliced TPC" method